

PHYS30121 INTRODUCTION TO NUCLEAR AND PARTICLE PHYSICS

Prerequisites: PHYS10121, PHYS20101

Follow-up units: PHYS40222, PHYS40322, PHYS40422, various fourth-year courses

Classes: 22 lectures in S3

Assessment: 1 hour 30 minutes examination in January

Feedback will be offered by tutors in examples classes. These classes will be based on weekly examples sheets; solutions will be issued.

Recommended text:

B. R. Martin, *Nuclear and Particle Physics: An Introduction*, 2nd ed. (Wiley)

Supplementary reading:

S. S. M. Wong, *Introductory Nuclear Physics* (Wiley)

K. S. Krane, *Introductory Nuclear Physics* (Wiley)

B. R. Martin and G. Shaw, *Particle Physics* (Wiley)

D. H. Perkins, *Introduction to High Energy Physics* (CUP)

Aims:

To introduce the fundamental constituents of matter and the forces between them, and to explore how these lead to the main features of the structure and interactions of subatomic systems (particles and nuclei).

Learning outcomes:

On completion successful students will be able to:

1. outline the basic constituents of matter and the fundamental forces between them
2. represent elementary processes by simple Feynman diagrams
3. use symmetries and conservation laws to identify the forces responsible for particular reactions and decays
4. use the quark model to explain the patterns of light hadrons
5. use simple models to explain the patterns of nuclear masses, sizes and decays
6. apply the independent-particle model to simple ground-state properties of nuclei

SYLLABUS

1. Basic concepts

Quarks, hadrons and leptons
Strong, electromagnetic and weak forces
Symmetries and conservation laws
Parity and charge conjugation
Feynman diagrams and exchange forces
Decay rates and scattering cross sections
Quark model for light hadrons
Parity violation in the weak interaction

2. Nuclei

Nuclear forces
Nuclear sizes
Semi-empirical mass formula
Nuclear stability
Alpha decay
Shell model

3. Particles

Three generations
Flavours and flavour mixing
Quark model with three flavours
Heavy-quark hadrons
CP violation
The origin(s) of mass